Developing a Computationally Efficient Dynamic Multilevel Hybrid Optimization Scheme using Multifidelity Model Interactions

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With the advent of massively parallel computers, computational speed has increased tremendously. Unfortunately, the scaling of computational models seems to always exceed compute times. This problem escalates when solving an optimization problem that requires many of these computationally intensive jobs to complete. Therefore, a dynamic algorithmic approach is proposed to make the optimization calculation more computationally efficient for a wide range of applications including earth-penetrator analysis, safety analysis, thermal analysis, and electrical device modeling.

If a system has models of differing fidelities, the low fidelity, computationally cheaper model may be used to perform a sequence of optimizations with periodic corrections via evaluations of the high-fidelity model. This is termed a surrogate based optimization strategy method[1] and is currently implemented within DAKOTA (Design Analysis Kit for Optimization and Terascale Applications). In addition, DAKOTA allows the user to develop customized heuristic optimization schemes with an arbitrary number of models. However, the resulting optimization schemes are hardwired and must be modified for each new optimization problem. The goal of this project is to take this capability a step further by developing algorithms with feedback mechanisms so that the processes of determining the optimization scheme and model fidelity are done dynamically. In effect developing a dynamic multilevel hybrid optimization scheme, using the multifidelity model interactions to reduce computational time.

To extend the DAKOTA toolkit's current capabilities to be much more dynamic, it will be integrated within the Entero environment. The Entero environment is a module-oriented, multi-physics, mixed-fidelity, system simulation environment for engineers that integrates and loosely couples external physics codes through a set of interfaces[2]. Integrating DAKOTA and its optimization process within Entero will allow a dynamic interchange of data between models of different fidelities during the iterative optimization process. This talk will discuss the progress of this implementation.

References

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